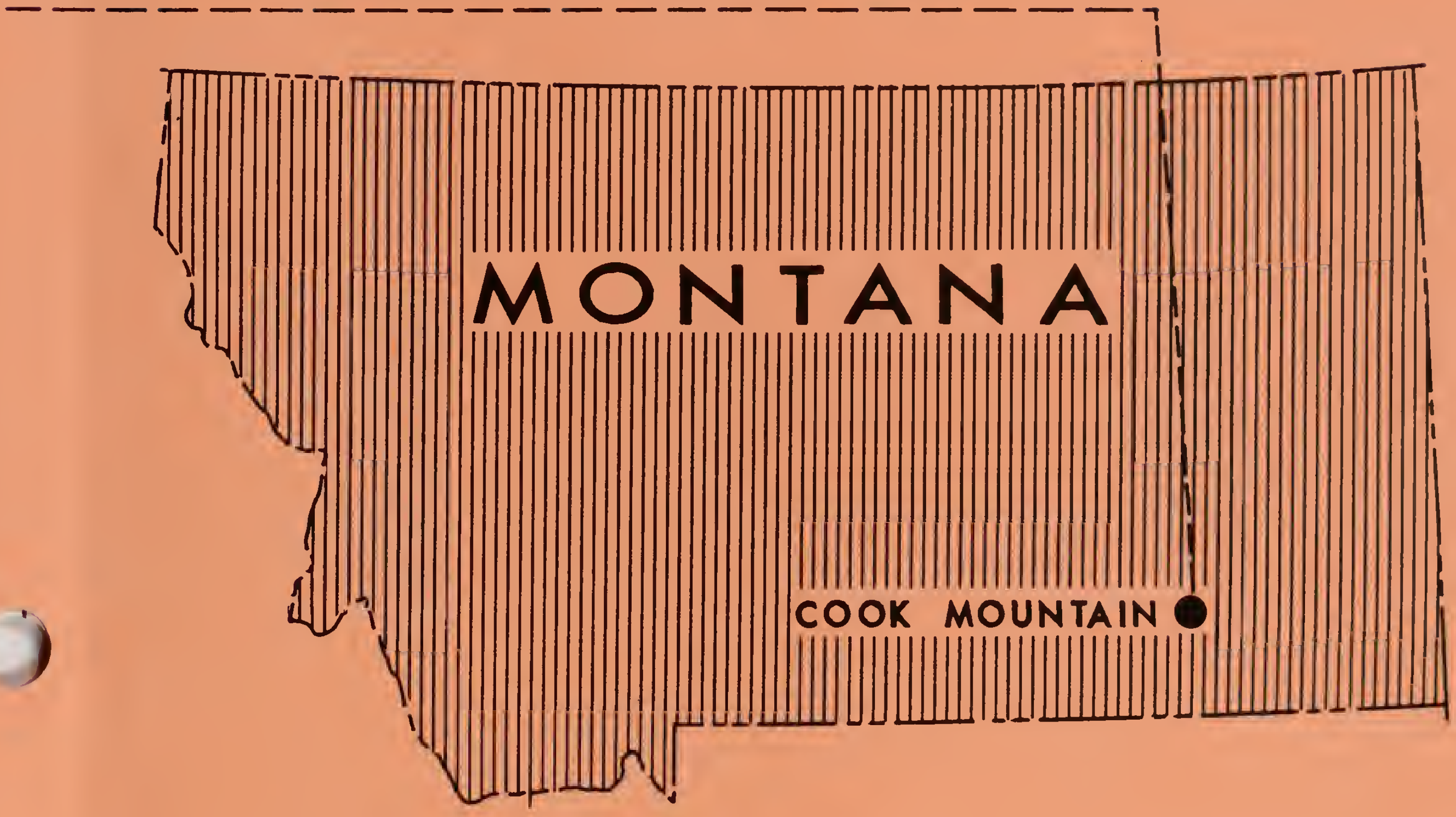
30-79

SUMMARY

Cook Mountain Study Area Report



RESOURCE & POTENTIAL RECLAMATION EVALUATION

Cook Mountain Study Area Report
Published March 1983

The Federal Coal Management Program has been designed as an interagency cooperative effort to meet national energy objectives.

Cook Mountain Study Area Report was prepared through the efforts of the U.S. Department of the Interior, principally the Bureau of Land Management and Bureau of Reclamation. The study effort began in 1979 and was concluded in 1983 with the publication of this report.

The area described in this report has been tentatively determined to be a potential Federal coal development area. The purpose of this report is to provide information on the area's reclamation potential, should coal development occur. This report will assist managers in making final Federal coal leasing decisions.

Limited copies of this report are available from:

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16. Abstract (Limit: 200 words)

The purpose of this investigation was to collect baseline data for establishing reclamation objectives and lease stipulations. The study area, located in southeastern Montana, lies within the unglaciated portion of the Great Plains Physiographic Province. The area is generally rolling and has been thoroughly dissected. Climatic conditions are characterized by warm summers, cold winters, and large variations in seasonal precipitation. Average annual precipitation is 13.8 inches; the frost-free season averages about 114 days. Bedrock exposed in the uplands and along deeply-incised drainages is the Tongue River Member of the Paleocene Fort Union Formation. Holocene alluvial deposits mantle drainage bottoms and a large upland terrace in the study area. Two coalbeds, the Knobloch and Sawyer, were penetrated by 24 drill holes in the study area. The Knobloch has a classified rank of subbituminous C; the Sawyer is ranked lignite A. The total estimated original resources in the study area for the two coalbeds combined is 367,170,000 tons. The alluvial/colluvial soils, which occupy about 20 percent of the study area, should yield 12 to 24 inches of easily stripped topsoiling material and 6 or more feet of fair to good quality subsurface material. Though they cover about 80 percent of the study area, the residual soils forming from sandstone or shale represent a limited source of revegetative material due to their shallow nature and the highly dissected uplands they occupy. Thirty-seven soil and overburden samples were stratified in the greenhouse as to their comparative revegetation potential.

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RESOURCE AND POTENTIAL RECLAMATION EVALUATION
OF
COOK MOUNTAIN STUDY AREA
ASHLAND COALFIELD
POWDER RIVER AND ROSEBUD COUNTIES
MONTANA

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INTRODUCTION

Recent energy shortages have drawn attention to the immense quantities of low sulfur coal that lie within the Rocky Mountain and Northern Great Plains regions. As a result, numerous investigations by the EMRIA (Energy Minerals Rehabilitation Inventory and Analysis) program have been undertaken by the U.S. Department of the Interior in order to quantify those coal resources and, at the same time, to provide sound reclamation guidelines so that the disturbed lands are restored to an acceptable condition.

PURPOSE

The purpose of this report is to provide baseline resource data for establishing reclamation objectives and lease stipulations. Detailed information is provided on geology, engineering geology, coal resources, coal quality, soil and overburden, and greenhouse investigations. Less detailed data is given on climate and physiography.

LOCATION

The Cook Mountain Study Area is located in southeastern Montana, within Powder River and Rosebud Counties, approximately 50 miles south of Miles City, and about 6 miles northeast of Ashland (Plates 1 and 2).

The site is comprised of 4549.8 acres of privatley-owned land (Plates 2 and 3) described as follows:

T. 2 S., R. 44 E.,	Section 24 (all)
T. 2 S., R. 45 E.,	Section 18 (all)
	Section 29 (S1/2)
	Section 30 (all)
	Section 32 (all)
T. 3 S., R. 45 E.,	Section 4 (W1/2)
	Section 6 (all)
	Section 8 (all)

All coal within the study area is owned by the Federal Government (Plate 3).

PRESENT LAND USES

The Cook Mountain Study Area lands are presently used for grazing (rangeland), timber production (forestland), and dry land farming (hay). The area also provides valuable habitat for wildlife with a high species diversity.

POSTMINING LAND USES

Postmining land uses are expected to be similar to the present uses (rangeland, forestland, hayland). Portions of the forestland would be cleared prior to mining, with potential conversion to cropland following reclamation if the landowner(s) so desires and the Montana Department of State Lands approves this alternative land use.

RULES GOVERNING MINING AND RECLAMATION OPERATIONS

In Montana, coal mine operators must comply with all established rules pursuant to the Montana Strip and Underground Mine Reclamation Act (1973). These rules are presented in Appendix A of the "Montana Permanent Program" for regulating surface and underground mining activities.1/

The Montana Department of State Lands is the regulatory agency responsible for administering this program.

OBJECTIVE OF RECLAMATION

Montana law presently requires the coal mine operator to restore all disturbed areas, "in a timely manner, either to conditions capable of supporting the uses they were capable of supporting before any mining or to conditions capable of supporting approved alternative land uses. Alternative land uses may be approved by the Department of State Lands after consultation with the landowner or the land-management agency having jurisdiction over the lands . . ." (Rule XVI, 5(c) pursuant to "The Montana Strip and Underground Mine Reclamation Act" - Montana Permanent Program).

Unless an alternative postmining land use is desired by the landowner(s) and approved by the Montana Department of State Lands, the main objective of reclamation in the Cook Mountain Study Area would be to establish a diverse vegetative cover with an interspersion of vegetative types over the reclaimed land capable of supporting livestock and wildlife. The integrity of the visual resource should be maintained.

CLIMATE

The Cook Mountain Study Area has a continental-type climate characterized by cold winters, warm summers, and large variations in seasonal precipitation.

The average annual precipitation in this area is about 13.8 inches. Of this amount, approximately 73 percent occurs between April and September. May and June are commonly the wettest months.

Thunderstorms and occasional hailstorms, most common in July and August, are caused by local convective heating. Damage to range plants from hail and heavy rainfall is usually minimal. However, the more intense storms may cause severe soil erosion, especially in steeply sloping and sparsely vegetated areas.

1/ The Montana Permanent Program was approved by the U.S. Department of the Interior, Office of Surface Mining, on April 1, 1980.

The total moisture provided by snowfall comprises about 23 percent of the annual precipitation in an average year.

Temperature extremes of 108 degrees F in summer and -42 degrees F in winter have been recorded in this area. The mean annual temperature is 45.1 degrees F.

The frost-free period (>32 degrees F) ranges from 108 days at Birney, Montana (Elevation - 3190 feet) to 120 days at Broadus, Montana (Elevation - 3030 feet). The growing season for hardy grasses (>28 degrees F.) in average years begins May 10 and ends 131 days later on September 19 (at Birney). Growth of native range plants is rapid during May and June. By mid-July, however, the available soil moisture is depleted and the plants mature or become dormant.

Climate will be an important controlling factor for revegetation in this study area. In most years, the spring rains provide adequate moisture to establish good stands of native vegetation. However, a drought year would severely limit revegetation efforts.

Several hazardous climate factors that could adversely affect revegetation efforts in this study area should be recognized. These include: (1) below normal or uneven distribution of precipitation, especially during the growing season; (2) intense thunderstorms or hailstorms that damage vegetation or cause soil erosion; (3) late spring freezes, and (4) depletion of soil moisture by wind. More detailed investigations will be necessary prior to mining to more accurately determine probabilities of occurrence of these factors. This data can then be used to predict best possible seeding times for revegetation.

PHYSIOGRAPHY

The Cook Mountain Study Area lies in the unglaciated Missouri Plateau section of the Great Plains Physiographic Province. The area is generally rolling and has been thoroughly dissected. Several prominent buttes, often capped by resistant clinker, rise above the divides which generally trend in a west-northwesterly direction through the study area. Maximum relief in the study area is 415 feet.

The study area, situated between Colbert Coulee to the north and Otter Creek to the south, is dissected by Double E Coulee and Cook Creek. With the exception of Otter Creek, all creeks are intermittent and flow in a westward direction toward the Tongue River. Drainages within the study area are deeply incised into shales, sandstones, and coalbeds of the Paleocene Fort Union Formation.

GEOLOGY

The Cook Mountain Study Area is located in the northern part of the Powder River Basin. This deep sedimentary basin is about 225 miles long and 90 miles wide. It extends from the Yellowstone River in Montana to the North Platte River in Wyoming and from the Black Hills of South Dakota to the Bighorn Mountains of Wyoming. Structurally, the basin is an asymmetrical syncline with a northwestward trending axis.

Bedrock exposed in the study area is the Tongue River Member of the Fort Union Formation of Paleocene Age. Unconsolidated alluvial deposits of Holocene Age mantle the valley floors and a large upland terrace.

Nine persistent coalbeds crop out or were penetrated by drilling in the study area. Two coalbeds are of primary economic significance. They are the Knobloch and Sawyer Coalbeds, which occur beneath the area generally within 250 feet of the surface.

Engineering property tests performed on bedrock materials similar to those in the Cook Mountain Study Area revealed that shear strengths are low. Slides can develop adjacent to high walls in surface mines, and saturated alluvial deposits and uncemented siltstones and fine-grained sandstone will readily erode and flow into excavations.

Excavation slopes will vary between minesites and will be dependent on exposure time, moisture conditions, material types, and depth of cut.

After disturbance, an increase of about 25 percent will occur in the volume of the overburden. Some areas of the surface will actually be higher in elevation after mining. Settlement will then occur for several years after reclamation until the materials reach a stable condition.

Three types of instability are common on reclaimed coal-mined areas in the Northern Great Plains. They are: (1) areawide settling, (2) localized collapse, and (3) piping. Each form of instability is affected by certain variables in the postmining landscape. These variables include the physical and chemical characteristics of the overburden, the method and equipment used in stripping and contouring operations, and the season when these activities occur. One or more of these types of landscape instabilities may occur on reclaimed land in the Cook Mountain Study Area.

Weathering tests were not conducted on samples from the Cook Mountain Study Area; however, results from the Otter Creek Study Site, located 7 miles to the southeast, indicated that freezing-thawing caused more weathering or breakdown than wetting-drying. The study also indicated that the materials weather at different rates, which will require various methods of handling, storing, and processing.

A study of the seismic history of the region indicates that minor damage could result to structures from earthquake shocks.

No significant paleontological finds were observed in the study area.

COAL RESOURCES

The Cook Mountain Study Area comprises a total area of approximately 7 square miles, located in the west-central portion of the Ashland Coalfield. The coal-bearing strata lie within the slightly southwestward dipping beds of the Tongue River Member of the Paleocene Fort Union Formation.

Two coalbeds, the 53-foot-thick (average) Knobloch and the 14-foot-thick Sawyer, were penetrated by 24 drill holes in the area. The Knobloch Coalbed has a rank classified as subbituminous C, with an average (as received) heating value of 8,666 Btu and the Sawyer Coalbed has a rank of lignite A with an average (as received) heating value of 7,894 Btu. The average ash content is 4.7 and 4.9 percent, and the average sulfur content is 0.12 and 0.44 percent, respectively, for the Knobloch and Sawyer Coalbeds.

The total estimated original resources in the Cook Mountain Study Area for the combined Knobloch and Sawyer Coalbeds are 367,170,000 tons. The Knobloch Coalbed contains 138,410,000 measured, 189,920,000 indicated, and 14,400,000 inferred tons. The Sawyer Coalbed contains 8,950,000 measured, 15,190,000 indicated and 300,000 inferred tons.

SOIL AND OVERBURDEN

Soils of the Cook Mountain Study Area can be grouped into two major categories based on their parent material, mode of development, and landform position. These are: (1) Residual soils developing from sandstone, siltstone, shale, or baked rock (clinker) which occupy ridges, tabular divides, and moderate to steep upland slopes, and (2) Alluvial/Colluvial soils forming in mixed deposits on fans, footslopes, terraces, and bottomlands. The residual soils occur over appoximately 80 percent of the study area; the alluvial/colluvial soils comprise the remaining 20 percent.

The residual soils occur on the dissected, sedimentary uplands of the study area. The parent materials of these soils are interbedded sandstone, siltstone, shale, and baked rock belonging to the Tongue River Member of the Fort Union Formation. In general, these soils are shallow to moderately deep, averaging about 20 inches to the underlying parent strata. Textures range from moderately coarse to fine, depending on the nature of the parent material.

As a source of revegetative material, these soils are fair to good in quality, but limited in quantity due to their shallow nature. Also, stripping operations may be difficult due to steep slopes, vegetative cover (trees), and bedrock outcrops, which are common on crests and along steep slopes.

The alluvial/colluvial soils occur on upland fans, footslopes, and terraces, and in bottomland positions along Cook Creek and Double E Coulee. These soils are moderately deep (fans, footslopes) to deep (high terraces, bottomlands), developing in stream-laid deposits or slope wash derived locally from sandstone, siltstone, shale, and baked rock of the Tongue River Member, Fort Union Formation. Soil textures are predominantly medium, but vary locally with the nature of the deposits. In most cases, these soils are nonsaline, nonsodic, and slowly to moderately permeable. Locally, however, the subsurface horizons are moderately saline, moderately to strongly sodic, and/or very slowly permeable. These unfavorable properties are inherited primarily from saline shales, which are exposed at the surface in numerous locations within the study area.

These soils represent an abundant supply of good quality revegetative material. Local subsurface horizons influenced by salinity, sodicity, or high clay percentage will require special placement below the plant rooting zone in reconstructed profiles. Stripping operations should not be difficult, with the exception of tree/brush removal in bottomland areas.

A semidetailed land suitability classification of the Cook Mountain Study Area was made to evaluate and characterize the soil and overburden to 10 feet in depth as a source of material for resurfacing and revegetating the area if it is surface-mined. This classification provides data on the quantity and quality of material for revegetation, ease of stripping and stockpiling the usable material, and other factors which affect the land's suitability for reclamation and revegetation.

Four land classes: 1, 2, 3, and 6 were established to group land of equal suitability for the specific use of revegetation. Class 1 lands provide the most desirable and plentiful source of easily stripped revegetative material. Land in this class may have surplus suitable material that can be utilized in deficient areas. Class 2 lands have adequate supplies of resurfacing material, but it is generally of lower quality than Class 1 or somewhat difficult to strip. Class 3 lands are marginally suitable, but can generally meet the planting media needs for their revegetation. Class 6 lands lack adequate quantities of suitable material to meet the needs for revegetation. If these lands are disturbed by surface mining, it will be necessary to borrow material from areas with adequate supplies or modify the material available for revegetation. A detailed description of the land suitability classes is included in Table 32 in the main report.

The results of the land suitability classification of the Cook Mountain Study Area expressed as a percentage of the area are as follows: Class 1 - 22.7; Class 2 - 12.0; Class 3 - 23.6; and Class 6 - 41.7.

The alluvial/colluvial soils, which cover about 20 percent of this study area, will provide an abundant source of material for revegetation. The combined thickness of the A and B horizons of these soils ranges from 12 to 24 inches. This material, which is nonsaline, nonsodic, and moderately permeable, will be highly desirable for surface replacement since most of the organic matter and available nutrients are contained in these horizons. In most cases, the C horizons of these soils will provide 6 to 8 (or more) feet of fair to good subsurface material.

The residual soils, though they cover about 80 percent of the study area, represent a limited source of revegetative material due to their shallow nature and the "broken" landscape they occupy.

Geologic core samples from two Intrasearch, Inc., drill holes were evaluated as to their suitability for use as supplemental plant media. A complete set of laboratory data, including trace element determinations, provided the data base necessary to evaluate the core materials. Suitability criteria (listed in Table 37 in main report) were applied to the laboratory data in order to place the materials into one of three classes: Suitable, Limited Suitability, or Unsuitable.

Overall, approximately 44.9 percent of the core materials lying above (overburden) and directly below (interburden) the Knobloch Coalbed in drill hole 24530-2C were determined to be suitable for use as supplemental plant media; 42.6 percent were of limited suitability; and 12.5 percent were unsuitable. In drill hole 3458-2C, 15.1 prcent of the overburden/interburden materials were rated suitable; 55.8 percent were of limited suitability; and 29.1 percent were unsuitable.

The major limiting factors in the materials classified as limited suitability or unsuitable were high levels of exchangeable sodium, high clay percentage, and/or excessive levels of trace elements, i.e. - lead, in two shale samples. Salinity was low in all but three of the samples, in which it was moderate. The core materials which were rated as suitable consisted primarily of fine-grained sandstones or sandy shales which were nonsaline, nonsodic, and medium textured.

GREENHOUSE EVALUATION OF SOIL AND OVERBURDEN MATERIALS

The data in this section was provided by E&A Environmental Consultants, Inc., Sharon, Massachusetts, under Bureau of Reclamation Contract Number 1-07-DV-00124.

Thirty-seven soil and overburden samples obtained from 7 USBR Point Site soil profiles in the Cook Mountain Study Area, Montana, were evaluated in this greenhouse study. A summary of the findings is as follows:

1. Germination of barley occurred in all soils.

2. Soil crusting, compaction, cracking and other soil surface problems were very prominent in many of the samples. Future evaluations should consider soil physical parameters.

3. The concentration of metals in the samples prior to planting did not indicate any toxic levels.

4. SAR and EC values were high for several samples and could affect plant growth.

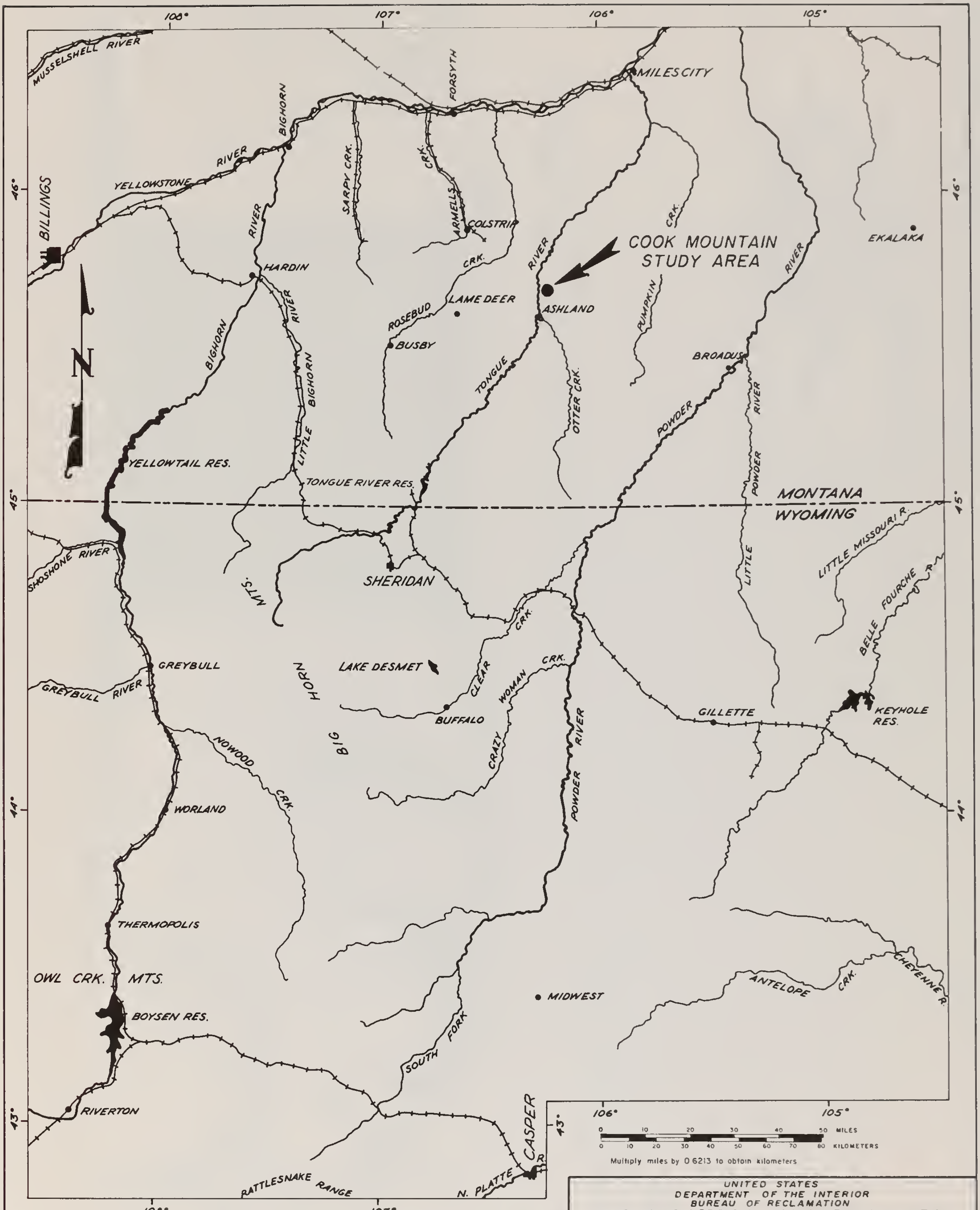
5. Four of the seven sample groups showed significant differences in dry weight yields as related to soil/overburden depth. Yield in the surface layer was generally significantly better.

6. The low shoot/root ratio in some of the samples tested indicated possible toxicity to plant growth. More study is needed in this area.

7. Plant tissue annalysis showed that six elements (P, CA, Na, B, Mn, and Mo) were significantly correlated with plant dry weights.

8. Most of the elements analyzed were within ranges reported in the literature.

The greenhouse serves as a valuable tool for stratifying overburden materials as to their relative productivity. This type of evaluation appears to be a very useful part of a screenable testing program. The combined greenhouse and laboratory data are keys to identifying the nature and extent of further evaluations that are necessary to accurately predict revegetation potential of various soils and overburden.



● COOK MOUNTAIN STUDY AREA

UNITED STATES
DEPARTMENT OF THE INTERIOR
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RESOURCE & POTENTIAL RECLAMATION EVALUATION

COOK MOUNTAIN STUDY AREA - MONTANA

GENERAL LOCATION MAP

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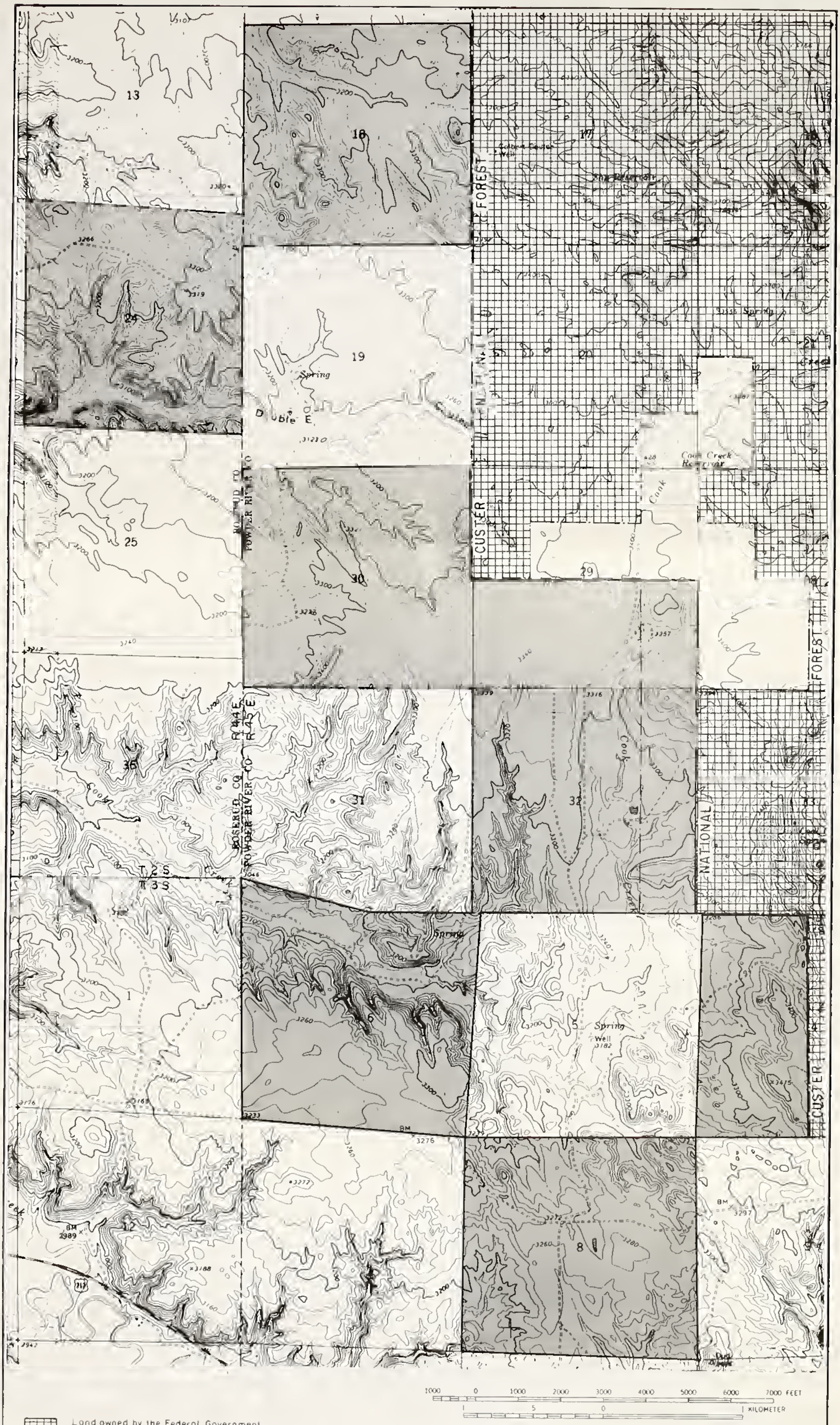

▦ Land owned by the Federal Government. (Custer National Forest)

(All other land is either state or privately owned).

▨ Study area.

Topography from U.S.G.S. 7.5' Quadrangles.

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RESOURCE AND POTENTIAL RECLAMATION EVALUATION
COOK MOUNTAIN STUDY AREA
ASHLAND COALFIELD, MONTANA

LOCATION AND LAND OWNERSHIP MAP

GEOLOGY F. CALCAGNO FIELD APPROVAL
DRAWN L.E. ALLSOP TECHNICAL APPROVAL
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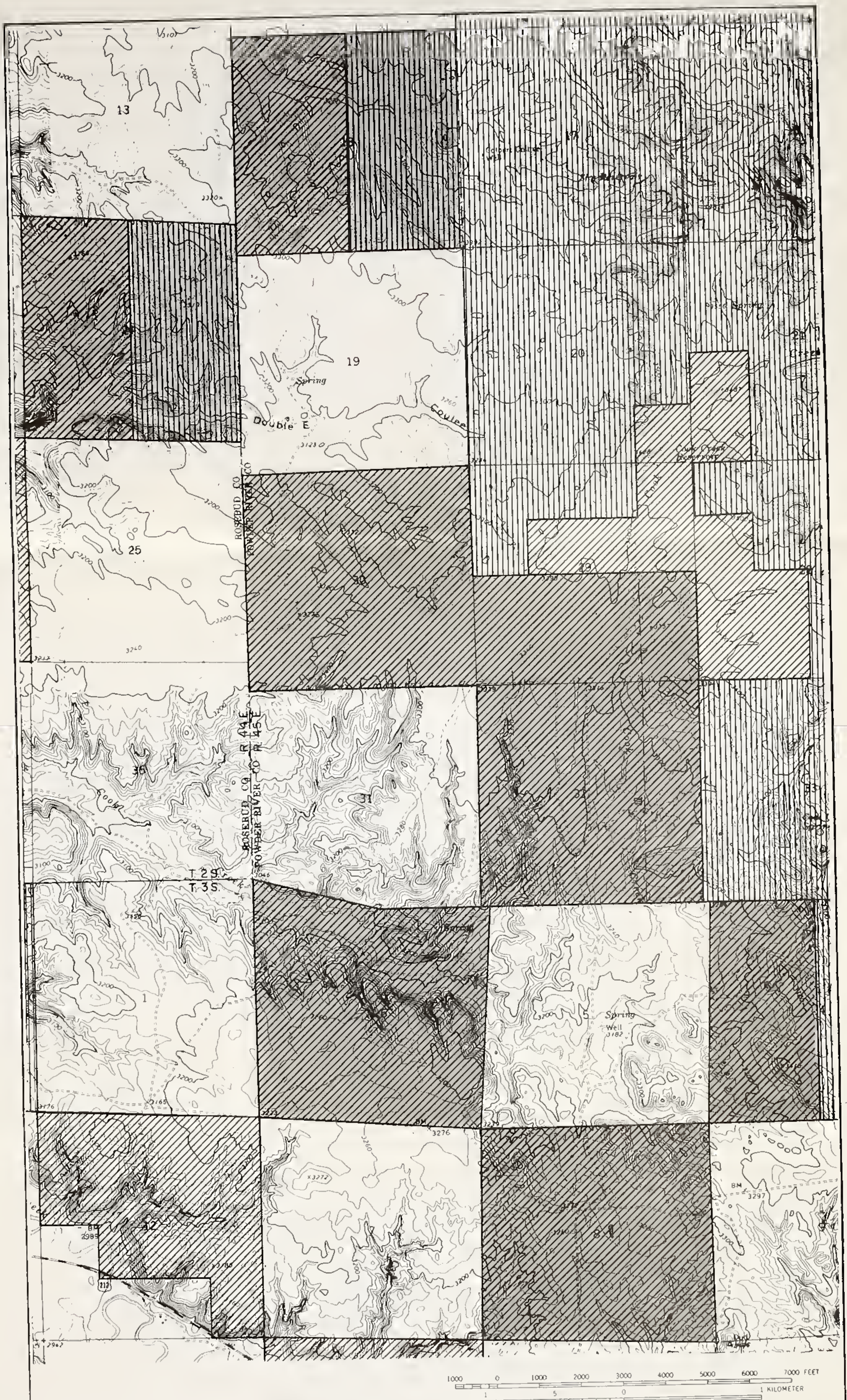
REGIONAL ENGINEER
BILLINGS, MONTANA OCT., 1981 1305-600-198

Plate 2



MINERALS OWNED BY
FEDERAL GOVERNMENT

- ▥ All minerals
- ▨ Coal only
- ☐ No Federal minerals
- ▩ Study area

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RESOURCE AND POTENTIAL RECLAMATION EVALUATION
COOK MOUNTAIN STUDY AREA
ASHLAND COALFIELD, MONTANA
MINERAL STATUS MAP

GEOLOGY F. CALCAGNO FIELD APPROVAL
DRAWN L.E. ALLSOP TECHNICAL APPROVAL
CHECKED APPROVED
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BILLINGS, MONTANA OCT., 1981 1305-600-199

Plate 3

Topography from U.S.G.S. 7.5' Quadrangles.

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